FREE NUCLEAR INDUCTION IN AMORPHOUS POLYMERS AND VISCOUS LIQUIDS ABOVE THE GLASS TEMPERATURE*

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An experimental and theoretical study has been made of the temperature dependence of the form of the free induction signal (FIS) using PS and a low molecular viscous liquid, dioctylphthalate, as examples. A relationship for the form of the FIS is obtained on the basis of a hypothesis about the existence, in any viscous system, of random magnetic fields which, over a wide temperature range, are not averaged to zero by movement.

STUDY of the free nuclear induction signal (FIS) in amorphous polymers and viscous liquid above the glass temperature T_g shows that the form frequently deviates from the exponential form which is predicted by the model of isotropic rotational Brownian movement of the molecules [1]. A fairly good formal description of the FIS curve may frequently be obtained by introducing empirical spectra of correlation times τ_c [2]. The distributions of τ_c introduced and their parameters do not however, have a clear physical interpretation. The features of the FIS in viscous liquids have been discussed [3] as the result of fluctuations in the density of the medium surrounding the molecules. According to the theory put forward in [4], the complex FIS in polymers is a consequence of entanglements between molecules and the anisotropy in the motion that arises. The effect of distributions of molecular masses in the polymer on the shape of the FIS has been noted [5]. A non-exponential FIS has been explained by the "two phase" nature of the amorphous polymer [6].

An experimental and theoretical study of the temperature dependence of the FIS form has been undertaken in the present work, using PS and a low molecular viscous liquid, dioctyl phthalate, (DOP) at $T > T_g$ as examples. The hypothesis of the existence in all viscous systems of random magnetic fields, the average values of which are not reduced to zero by motion over a wide range of temperatures, lies at the basis of the consideration of the form of FIS.

FIS were measured with a coherent pulse spectrometer working at a frequency of 16·5 MHz with protons in the temperature range —80 to +150°C. The FIS curves were recorded after the action of a $\pi/2$ radiofrequency pulse. For DOP at $T >$ —30°C, the spin-echo envelope

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